U.S. Army Aeromedical Research Laboratory

Annual Progress Report

Calendar Year 1997

Reported by

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March 1998

U.S. Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362-0577

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The Annual Progress Report gives the CY 97 personnel and funding strength of the U.S. Army Aeromedical Research Laboratory. This report includes an overview of the Laboratory activities, current areas of research, and a brief description of the research being conducted.

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BACKGROUND

The U.S. Army Aeromedical Research Laboratory (USAARL) was established in 1962 to accomplish research in support of Army aviation and airborne activities, and to provide a central aeromedical research and reference library. In 1974, medical research programs in acoustics and vision were added to the Laboratory's mission. USAARL's mission was further expanded in 1977 to include the assessment of health hazards and research in support of both air and ground vehicles and weapons systems. In spite of this mission expansion, USAARL's primary mission remains medical research support of Army aviation.

Scientists and engineers assigned to USAARL seek to enhance force effectiveness by preventing or minimizing health hazards created by military systems, doctrine and tactics. Specifically, they identify, investigate and solve medical and health-related problems, which deter soldiers/aviators from performing their mission, or compromise their safety. Co-location with the U.S. Army Aviation Center allows USAARL's unique mix of scientific personnel to successfully conduct critical research for solving operational medicine problems for our aviators. Additionally, USAARL provides military developers with information and expertise to enhance the performance and safety of future Army systems.

USAARL maintains close coordination with other services and the international allied medical research community as a member of the North Atlantic Treaty Organization (NATO) Advisory Group for Aerospace Research and Development (AGARD), the Triservice Aeromedical Research Panel (TARP), and as a participant in the Air Standardization Coordinating Committee (ASCC).

This report presents an overview of USAARL activities during calendar year 1997 (CY97), identifies current areas of research, and gives a brief description of the research programs being conducted.

MISSION

Conducts research and development on health hazards of Army aviation, tactical combat vehicles, selected weapons systems, and airborne operations. Assesses the health hazards from noise, acceleration, impact, and visual demands of such systems and defines measures to offset hazards. Assesses stress and fatigue in personnel operating these systems and develops countermeasures. Assists in development of criteria upon which to base standards for entry and retention in Army aviation specialties. Assists other U.S. Army Medical Research and Materiel Command (USAMRMC) laboratories and institutes research on the impact of continuous operations on individual and crew performance and development of improved means of patient evacuation. Assesses current life support equipment to identify causes of failure and devises improved design. Assists the combat developers and materiel developers of new Army aviation and tactical combat vehicle systems to recognize and eliminate health hazards as early as possible in the developmental cycle. Conducts collaborative research with other Department of Defense and federal agencies on medical research and development issues of common concern.

FROM THE COMMANDER

The United States Army Aeromedical Research Laboratory (USAARL) proudly presents this summary of achievements for calendar year 1997. This year our personnel made significant contributions to Army readiness through the continued accomplishment of our research mission.

USAARL continues to field the Crew Endurance Leader's Guide to all TO&E aviation commanders. A lecture package is also presented to the Aviation Battalion and Brigade Pre-Command Courses that occur quarterly at the Aviation Center, Fort Rucker. This provides a ready reference to help line commanders make informed decisions regarding management control of operational effectiveness in sustained operations.

Real-time, in-flight EEG data were captured and analyzed with respect to sustained operational alertness, providing a reference for predictive research designed to demonstrate real world effectiveness of sustained operations fatigue countermeasures. This EEG capture and analysis is a technological first, a research capability unmatched by any other facility in the world. USAARL should serve as the home station for all DOD investigations in this arena.

The continued assessment of single engine emergencies in dual engine aircraft has led to a change in training approach throughout the Army aviation community. Supplemental engineering adjustments have also been implemented in an attempt to reduce pilot error.

A novel instrument display has been designed and patented, integrating into one simple display the five key instrument flight parameters that are important to minimizing spatial disorientation (SD): Aircraft attitude, airspeed, altitude, rate of climb/descent, and aircraft heading.

A compilation of Army SD-related aircraft mishaps, obtained from the U.S. Army Safety Center database, has allowed our researchers to construct crew cockpit action scenarios that can be run on the UH-60 simulator. These scenarios permit aviators to experience first-hand, in a training environment, without prior indication or warning, the events and SD conditions that directly led to 18 different Class A mishaps.

Our visual acuity test has been distributed to Triservice clinics and research programs in order to standardize visual assessment paradigms. A related, color acuity test is in early development. The basic research that went into the development of proposed clinical testing dually benefits the line in terms of identifying personnel with superior visual skills, as well as assists in identifying those personnel who may require a visual assist in order to maximize their abilities.

USAARL remains dedicated to the support of our customer, the combat soldier aviator. We are proud of the singular work we have accomplished on their behalf and dedicate ourselves to this continuing mission.

Cherry L. Gafney

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Commanding

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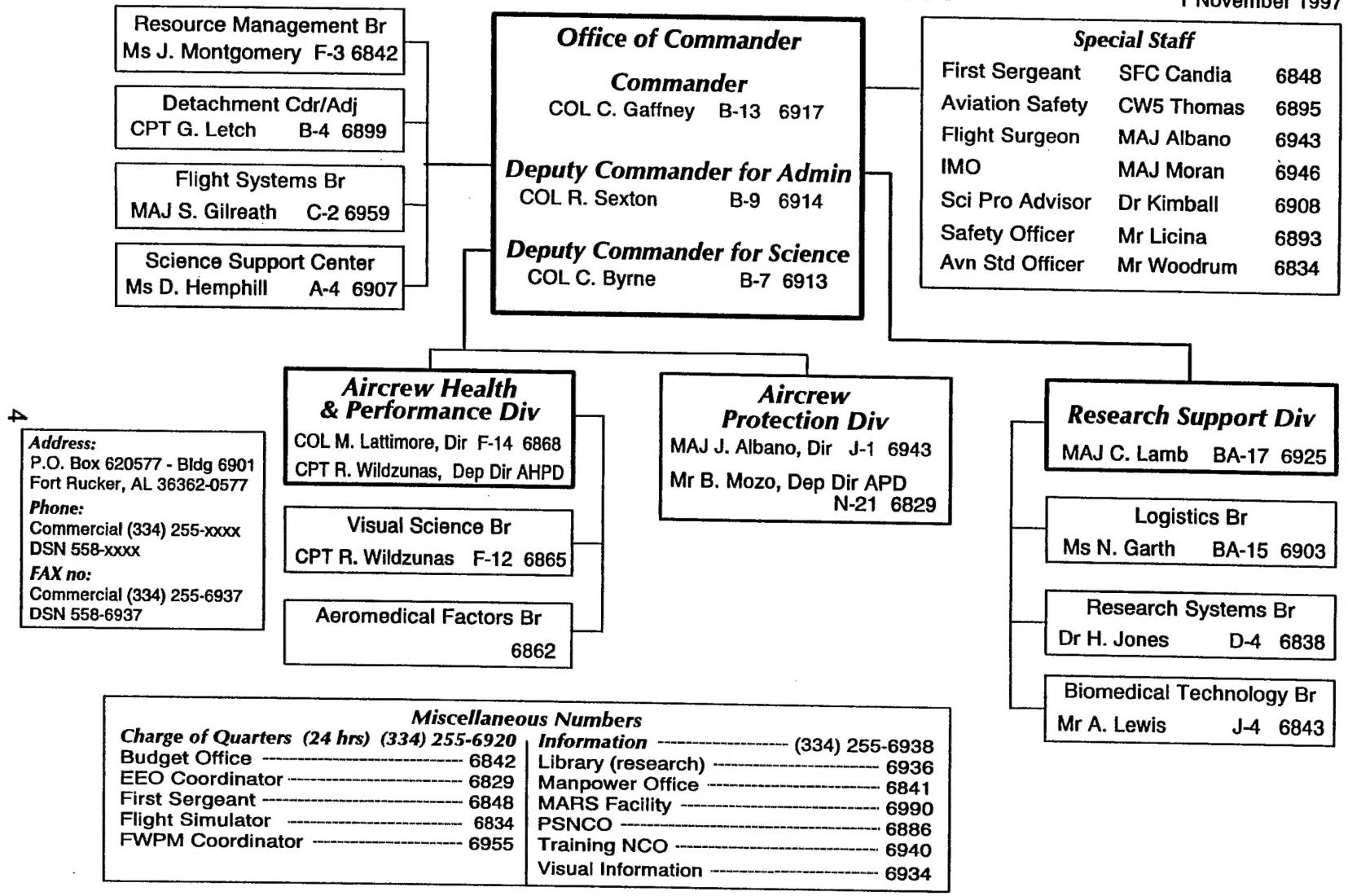
1 November 1997



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Miscellaneous Numbers

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Budget Office	6842	Library (research)	6936
EEO Coordinator	6829	Manpower Office	6841
First Sergeant	6848	MARS Facility	6990
Flight Simulator	6834	PSNCO	6886
FWPM Coordinator	6955	Training NCO	6940
		Visual Information	6934

PERSONNEL

As with the majority of organizations, USAARL continues to be impacted by downsizing within the Government. Continued loss of manpower authorizations, both military and civilian, deletes critical scientific skills and further intensifies the disparity between required and authorized strength levels. In order to meet continuing mission demands in light of these staffing limitations, in addition to the work force described below, USAARL added 4 temporary positions and a monthly average of 25 non-TDA personnel during CY97. Non-TDA personnel include Army student contractors, Army Research Office personnel present under the Summer Faculty and High School Math and Science Teachers Programs, and other on-site research and research support contractor personnel, exchange officers and casual officers.

Required strength was 31 officers, 2 warrant officers, 39 enlisted, and 78 civilians, for total requirements of 150. Authorized were 18 officers, 2 warrant officer, 31 enlisted, and 37 civilians for a total authorized strength of 88. The average assigned strength was 14 officers, 2 warrant officers, 36 enlisted, and 42 civilians, for a total average assigned strength of 94.

USAARL employs a highly skilled and trained work force with 67 percent of assigned employees possessing degrees. The types of degrees held by Laboratory employees in CY97 were: 3 M.D.s, 12 Ph.D./O.D.s, 10 Masters, 30 Bachelors and 8 Associate degrees.

Equal Employment Opportunity (EEO) Program:

Black Employment Program: USAARL provides a primary representative to the Fort Rucker Black Employment Program Committee (BEPC). This committee provides a forum to consider employment issues affecting blacks in the work force. The committee also works to develop and propose methods to overcome any identified barriers to employment, promotion, training, status, and recognition.

Black Civilian Employees: Three black females received a Successful 1 performance evaluation; one with a Quality Step Increase (QSI) and one with a 40-hour Time Off Award (TOA) and one with a monetary award. Five classes were attended (four local and one TDY) as compared to seven training courses (five local, two TDY and zero

correspondence) in CY96. As of 31 December 1997, there were 35 permanent civilian employees--3 black, for a representation of 9 percent--1 percent higher than in CY96.

Hispanic Civilian Employees: The total representation of Hispanic employee is one, or 2 percent of total civilians. This is one percent lower than last year. This employee received a Successful 1 evaluation, a Commander's award, and a promotion to GS-14. He accepted another position and departed on 22 Nov 97. One class was attended (one local and zero TDY) as compared to two courses (one local and one TDY) in CY96.

Handicapped Civilian Employees: USAARL had one handicapped employee who received a Successful 1 performance rating and retired on 27 Sep 97. This employee attended one class as compared to zero classes in CY96.

Women Civilian Employees: As of 31 December 1997, there were 16 female employees out of 35 permanent civilians, for 46 percent of the total. This is the same as last year.

Of the 16 female employees, all received Successful 1 evaluations. Of the 16, 15 received either a monetary award, QSI or a TOA. Two received an additional TOA as Civilian of the Quarter.

Twenty-eight classes were taken (22 local and 6 TDY) as compared to 15 courses (12 local, 3 TDY and 0 correspondence) in CY96.

Other Minorities: USAARL has one American Indian employee. He received a Successful 1 performance rating with a monetary award. One local training course was attended this year as compared to one class attended during CY96.

Federal Women's Program: USAARL supports the Federal Women's Program (FWP) by providing a representative and an alternate to the FWP Committee (FWPC). The FWPC representative acts as an advisor to managers on the upward mobility of women in the work force. The FWPC representative monitors employment, recruitment, awards, training, and promotions, and also alerts the Command when there are under representations.

Personnel Achievements:

Promotions: The military staff earned 6 promotions in CY97 ranging from E-5 to colonel. The civilian staff had one promotion of a black female to a Financial Manager, GS-13; and three white females to a Supervisory Tech Information Specialist, GS-13; Research Psychologist, GS-13; and Management Assistant, GS-7. One Hispanic male was promoted to a Research Psychologist, GS-14. Two white males were promoted to a Research Psychologist, GS-15; and a Computer Specialist, GS-11.

Awards: USAARL's highly motivated, productive staff was recognized for performance in CY97 with:

Military awards:

Army Commendation Medal	12
Army Achievement Medal	4
Meritorious Service Medal	3
Total	19

Civilian Awards: USAARL had an active awards program in CY97 with:

27 Performance Awards
6 Quality Step Increases
9 Time Off Awards
3 On-the-Spot Awards
1 Commander's Award
1 Meritorious Civilian Service Award
2 Civilian of the Quarter Awards

SCIENTIFIC PROGRAMS

USAARL scientific research encompasses three of USAMRMC's major research areas. They are systems health hazards, hazards of mechanical forces, and combat crew effectiveness. Under each of these research areas, USAARL has established scientific programs which are directed at fulfilling either an Army or a USAMRMC Scientific and Technology Objective (STO).

Titles, the DA Form 1498 accession number, and the USAARL division with the responsibility for these projects are listed below.

TITLE	DA ACCESSION NUMBER	DIVISION
Aeromedical Research of Operationally Significant Problems in the Army Aviation Environment	DA0G0151	Aircrew Health and Performance
Coping Strategies for Helicopter Pilots and Crews Involved in Night Operations	DA335655	Aircrew Health and Performance
Enhancement of Aviator Sleep and Performance Through Chemical Intervention	DA336185	Aircrew Health and Performance
Investigation of Spatial Disorientation and Related Topics	DA336186	Aircrew Health and Performance
Research Countermeasures for Significant Medical Hazards and Crew Life Support in Military Systems	DA0G0165	Aircrew Health and Performance
Aviation Epidemiology Data Register	DA308727	Aircrew Protection
Aviation Life Support Equipment Crashworthiness Evaluations	DA302870	Aircrew Protection
Biodynamics of Life Support Equipment and Personnel Armor	DA0G0167	Aircrew Protection
Auditory Performance Standards	DA361536	Aircrew Protection

Biomechanics, Simulations, Performance and Trauma Assessment and Protection from Accelerations and Repeated Impacts	DA320693	Aircrew Protection
Repeated Impact Tolerance Criteria for U.S. Army Ground Vehicles	DA336192	Aircrew Protection
Military Visual Performance	DA361539	Aircrew Health and Performance
Military Visual Problems: Assessment, Mechanisms, and Protection	DA0B6893	Aircrew Health and Performance
Visual Performance Issues of Flat Panel Technologies	DA336445	Aircrew Health and Performance
Methodologies for Assessing Retinal and Visual Functions	DA336446	Aircrew Health and Performance
Develop Criteria, Models and Evaluation Methodologies to Improve Aviator Communication Performance and Hearing Protection	DA360347	Aircrew Protection
Mechanism of Melatonin Action on Military Performance	DA360560	Aircrew Health and Performance
Aviator Status Monitoring	DA361534	Aircrew Health and Performance
Physiological and Performance Effects of Extended Operations and NBC Environments on Aviators	DA360559	Aircrew Health and Performance
Evaluation of Refractive Error Correction Methodologies and Military Implications	DA306074	Aircrew Health and Performance
Medical Equipment Airworthiness Certification Evaluations	DA361537	Aircrew Protection
Soldier Performance and Injury Based Design Criteria for Mass Properties of Head Supported Devices	DA361535	Aircrew Protection

MANAGEMENT ACTIVITIES

Technology Transfer:

USAARL maintained an active technology transfer program in CY97 through distribution of its technical reports, publication in the open literature, presentations to military and civilian audiences, execution of Cooperative Research and Development Agreements (CRDAs), and membership in federal, regional, and state technology transfer organizations.

USAARL CRDA partners in CY97 included:

Bethal College
Old Dominion University
Troy State University
University of Houston College of Optometry
University of Alabama at Birmingham School of Optometry

Allied Health Care	BCI International
Bose Corp.	Gentex
Grumman	Heartstream
Koch & Sons	Lifecare
PhysioControl	Simula
Spectrum	Zoll

Science Support Center:

The Science Support Center (SSC) library provided the information necessary to support the aeromedical research performed at USAARL, supported three Flight Surgeon Courses and one Aeromedical Psychologist Course, and disseminated scientific information to requesters worldwide. The library holdings are believed to comprise the most comprehensive aviation medicine collection in this part of the country.

Audiovisual and editorial services contributed to the publication of USAARL technical reports and open literature publications. These services also produced video documentaries, brochures and pamphlets describing research conducted by USAARL.

Resources Management:

Program funding for FY97/98 (dollars in thousands):

	FY97	FY98
6.1 Basic Research	348	807
6.2 Exploratory Development	4,169	3,909
6.3 Advanced Technology Development	18	0
6.4 Demonstration & Validation	0	20
Other	165	152
TOTAL	4,700	4,888

Flight Activities:

Aviation research/research support was provided by six assigned active duty Medical Service Corps (MSC) aviators, a Chief Warrant Officer Five (CW5), a Department of the Army Civilian, and a contract instructor pilot from Raytheon Services Company. The majority of the aviators fly at least two of USAARL's aircraft for research support.

Assigned aerial research platforms (TDA authorized aircraft) in CY97 were:

JUH-1H	71-20033
JUH-60A	88-26069
JC-12C	73-22265
JC-12D	81-23541
NUH-60FS	Simulator

Flight hours in USAARL aircraft in CY97 were:

Fixed wing hours	425
Rotary-wing hours	427

Simulator and its peripherals utilization 1,881

During CY97, USAARL aviation platforms were used for the following research studies:

JUH-1H	Telemetry, Spatial Disorientation, and Flat Panel Novel Display
JUH-60A	Vibrotactile Vest, Telemetry, Tactile Situational Awareness System
JC-12C	Melatonin and research support
JC-12D	Melatonin, ALSERP, and research support
NUH-60FS	Sea Warrior, NVG/Simulator Compatibility, Head-tilt, Airbag, Novel Display, Flat Panel, Spatial Disorientation, Tactile Situational Awareness System, Mass Properties, Aviation Psychology, Modafinil, and Sleep Deprivation.

Three significant events greatly affected USAARL flight activities in CY97. The JC-12C was turned in for a JC-12D due to the Aviation Life Support Equipment Retrieval Program needing a cargo door in the fixed wing aircraft, and the scheduled retirement of older C models. The subsequent turn-in of aircraft 73-22265 and issue of aircraft 81-23541 happened within a 2-week time frame in May 1997. The Head-Up Display (HUD) modification work order (MWO) was installed in the JUH-60 requiring several weeks' down time, and a major scheduled maintenance phase inspection which kept the aircraft down for 2 months, July and August 1997. Our JUH-1H had a scheduled maintenance phase inspection, Global Positioning System modification, and a Safety of Flight, which kept it down for maintenance for a total of 3 months in 1997.

Standardization/Aircrew Training Program

Army Regulation 95-1, Aviation Flight Regulations, was extensively changed this past year which greatly impacted the Aircrew Training Program at USAARL. Our unit aviation standard operating procedures and individual aircrew training folders were

updated to reflect the required changes. A total of 18 instrument and contact evaluations were administered, along with 12 no-notice pilot, pilot in command, and instructor pilot evaluations.

One of Flight System's primary support areas was the Airworthiness Certification and Evaluation (ACE) Program. During CY97, Flight Systems dedicated 414.8 hours to the ACE Program. Actions included: In-flight evaluation of three medical devices intended for use on rotary-wing aircraft, coordination with several agencies to upgrade the mission equipment on USAARL's JUH-60A, and consultation in redesigning the testing process for carry-on medical equipment with the U.S. Army Aviation and Missile Command.

Personnel Research/Research Support Dedicated Hours

ACE Program	414.8 hrs	Telemetry	392.3 hrs
TSAS	373.3 hrs	SD Training	302.4 hrs
Head-tilt	193.9 hrs	UH-60Q	117.0 hrs
SD Sorties	95.5 hrs	Melatonin	82.0 hrs
Airbag Study	70.4 hrs	Sea Warrior	40.0 hrs
Other Projects	42.2 hrs		

TOTAL: 2,123.8 hrs

Training:

USAARL's training program for CY97 included 60 training experiences. Training encompassed supervisory development training, software training, training required by Equal Employment Opportunity mandates, and training to assist employees to perform more effectively in their current positions.

RESEARCH ACTIVITIES

Aircrew Health and Performance Division:

Aeromedical Factors Branch:

Aircrew Endurance and Sustainment and Aviator Status Monitoring

Sustained and continuous operations play a critical role on the modern battlefield, but can impose sleep loss and fatigue which significantly decrease aviator performance. The Sustained Operations Team has developed numerous countermeasures to ensure that Army aviators function effectively despite the physical and psychological demands of sustained and continuous operations. Biomedical, behavioral, and psychophysiological studies are conducted to better understand the effects of stress and fatigue on aviator performance; such studies permit the development of appropriate countermeasures. This research team also investigates the efficacy of pharmacological agents for sustaining helicopter pilot performance during periods of sleep disruption or deprivation.

During 1997, the Sustained Operations Team completed the first ever in-flight study of the efficacy of real-time, in-flight EEG recordings as a means of assessing pilot alertness and performance under the new 1498 start titled Aviator Status Monitoring. The team submitted several open literature papers on this topic, additionally offering meeting presentations at national and international forums. Open literature articles on the use of dexedrine in sustained operations were published this year; a refined dexedrine follow-up study is in preparation. Parallel research on the stimulant Modafinil is planned for next year. Research was completed in the investigation of drug-induced (zolpidim) short naps for sustaining performance and vigilance during sleep deprivation similar to what would be encountered in protracted combat operations. Research has similarly been initiated to evaluate the effectiveness of short bouts of intense exercise for sustaining performance and vigilance during periods of sleep deprivation similar to what would be encountered in prolonged combat operations.

Coping Strategies for Shiftlag/Jetlag

Mission-driven changes in work schedule and rapid deployment can produce stress, fatigue, and sleep deprivation that limit aircrew performance and impede the accomplishment of Army aviation missions. The Aviation Shift-Lag Team develops countermeasures to maintain aviator performance which are implemented and tested in both laboratory and field environments. This team also accompanies aviation units to the field, studies their work schedules and environmental conditions, evaluates their crew rest plans, and implements new strategies for future operational and training deployments. The team works in collaboration with the Federal Aviation Agency's Civil Aeromedical Institute (CAMI) to determine the efficacy of fatigue countermeasures on cognitive performance of air traffic control personnel working at night, international inspectors traveling across time zones, and Coast Guard personnel conducting rescue missions.

In 1997, the Aviation Shift-Lag Team conducted a field study on the half-life of the 10-mg dose of melatonin during deployments and night operations. Melatonin proved to be effective for stabilizing sleep/activity rhythms and for maintaining alertness during night operations. Moreover, laboratory results showed melatonin to be effective for shifting sleep times, with minimal adverse effect on performance. Data from previous studies, which evaluated the effects of melatonin on the menstrual cycle and hormonal variations in females, have been completed yielding the development of two technical reports and two open literature papers. A study on the prophylactic effect of napping on nighttime performance for air traffic controllers was completed in conjunction with the FAA. Data collection, analysis, and a final report on activity/rest cycles of U.S. Coast Guard personnel were completed in July 1997 as a customer-funded project for CAMI. In June 1997, an article on the effects of institutional countermeasures was published in the International Journal of Psychology. The Crew Endurance Leader's Guide, which specifies how stress, fatigue, lack of sleep, and shift/jet lag can be controlled and managed in military environments to improve soldier performance, enhance mission accomplishment, and minimize the risk of hazards is continuing to be distributed. Aviation Battalion and Brigade Pre-Command Course presentations on the topic are also continuing.

Crew Coordination

USAARL conducted an evaluation to validate a quantitative method for achieving optimal information hierarchies based on designer inputs for weighing factors that account for the relative importance of various cognitive and functional human factor considerations. We developed a system for quantifying crew coordination using sequential analytical methods. Adequate reliability of the coding system was obtained, and the system has been validated through analysis of videotaped simulator sessions involving single engine emergencies. The system will be used to evaluate crew coordination in the 160th Special Operations Aviation Regiment. Proposed presentations have been submitted to the NATO Research and Technology Organization Symposium on collaborative Crew Performance in Complex Operational Systems (Edinburgh, UK, 20-24 Apr 98), and the Aerospace Medical Association (AsMA) 1998 Scientific Meeting (Seattle, WA, 17-21 May 98). Planned extension work is scheduled involving the joint integration crew coordination and spatial disorientation research.

Miscellaneous Aeromedical Human Factors

Aeromedical human factors include a vast number of practical issues of importance to Army aviation units and personnel for preventing aircraft accidents and to assist in achieving maximum possible performance during physically and psychologically demanding mission scenarios. Hot weather is an example of an environmental stressor that can adversely affect aviator endurance and flight performance. Heat stress during aviation operations in hot weather areas is a potential hazard that can limit mission duration. A research study using USAARL's UH-60 research flight simulator was published in support of the Air Warrior Program Manager to evaluate the effects of heat stress on pilots wearing the current unencumbered MOPP0 aircrew battle dress uniform (ABDU) versus an encumbered MOPP4 ABDU ensemble. Mission endurance times and various measures of flight performance were significantly reduced when pilots flew the simulator in the hot condition while wearing the encumbered ensemble.

Multifunction information display (MFD) and control systems are becoming increasingly common in Army helicopters, yet the cognitive and psychomotor human factor issues involved in their design and use have not been sufficiently delineated. Improperly designed MFDs may result in confusion and inability to navigate to the necessary display pages during emergencies or in the stress of a combat environment. Of particular concern is preventing suboptimal design of the hierarchy of data and control functions distributed

over potentially hundreds of display pages. In collaboration with the Purdue University School of Applied Psychology, a quantitative algorithm was developed for the design of MFDs that simultaneously optimize cognitive and psychomotor human factors. This algorithm, which attracted considerable interest at the DOD Human Factors Engineering Technical Advisory Group Meeting, will be described fully in an upcoming technical report.

Visual Sciences Branch:

Mechanism Assessment of Military Visual Problems

In 1997, we ran visual performance measures (visual acuity, color discrimination, health hazard assessment) in support of the Comanche helmet mounted display (HMD). Low light level wire strike avoidance devices were developed, patented, and field-tested.

A partial model for the prediction of gunner performance was established. XM40 and XM45 Aircrew Protective Masks (as well as the unnamed next generation protective masks) were studied in reference to proposed design specification changes and their compatibility with electro-optical devices. An additional evaluation was performed on the proposed replacement polycarbonate lenses for the XM40 mask. Current efforts include: analysis of possible effects of light interference filters on the ANVIS head-up display system performance, evaluation of laser filtering devices, participation on a source selection board for the same, and field of view analysis for the various protective masks in development.

Single engine helicopter emergencies have resulted in fatal accidents. In the previous year a General Officer Steering Committee requested that USAARL determine whether erroneous pilot reactions to single engine helicopter emergencies are a systemic problem, and if alternate procedures or design modifications will improve the man-machine interface. A multiphase effort was conducted in conjunction with the U.S. Army Safety Center, including accident investigation, database search, survey, and simulator study. The results indicate that when a pilot is confronted with a single engine emergency, there is a 1 in 6 chance of significant error. These data demonstrated that inappropriate pilot responses stem from crew coordination and diagnostic problems, not visual identification problems.

Spatial Disorientation

Spatial disorientation (SD) is a contributing factor in as much as 30 percent of all Army helicopter accidents. USAARL's SD team directs its efforts at reducing the incidence of SD in Army aviation thereby enhancing flight safety and operational effectiveness. The SD research approach is comprised of three components: (1) analysis of aviation accident data to determine pilot, cockpit, mission, and environmental factors associated with SD; (2) evaluation of aids to prevent or help overcome SD in flight; and (3) development of new training and instructional methods to enhance pilot and command understanding and awareness of SD.

The contribution of SD to accidents remains high, and over the last 10 years, is responsible for an average annual loss of approximately 14 lives and $58 million. A study to examine the particularly high rate of SD accidents during night aided flight is under way. A study to assess the efficacy of spatial disorientation training sorties for enhancing aircrew awareness of SD has been completed. A technical report using SD-induced mishap scenarios is currently in preparation. As part of an operational, product-oriented effort to prevent SD, a prototype, integrated, USAARL-developed, flight instrument display was developed in the Laboratory's UH-60 flight simulator, and subsequently assessed in flight on the Laboratory's UH-1 and UH-60. Subject pilots flew an instrument flying task and recovered from unusual attitudes. A technical report of this study, which confirms the advantage of this novel display over standard flight instruments has been published. Several additional reports have been published for projects conducted during 1997. These include: A normative database of postural equilibrium in aviators; assessment of postural equilibrium before and after exposure to the AH-64 combat mission simulator; and an assessment of pilot head tilt during simulated day and NVG flight. Planned extension work is scheduled involving the joint integration of SD and crew coordination research.

Refractive Error Correction Methodologies and Military Implications

Approximately one-third of active Army spectacle-wearing aviators are presbyopic, and therefore require bifocal correction. A four-phase study was conducted to compare performance of bifocal soft contact lenses to bifocal spectacles. While vision was slightly better with spectacles, performance on flight simulation maneuvers was better with bifocal contact lenses than with spectacles. In-flight testing revealed that all pilots preferred bifocal contacts to bifocal spectacles. These findings indicate that bifocal

contact lenses are an acceptable alternative to spectacles for presbyopic aviators and were published in a technical report in July 1997.

Advanced technologies have now been applied to the refractive error and spectacle incompatibility problem of modern visionic and electro-optics systems. While incisional refractive error correction methods (i.e., radial keratotomy or RK) have proven to have major problems in the military setting, no such problems have yet been documented by laser techniques (photorefractive keratectomy or PRK). Given the recent FDA approval of routine PRK treatment of myopes up to a -6.00 diopter correction, individuals having received this treatment prior to military service will be entering service in ever-greater numbers. Therefore, it is imperative that a proactive research program, examining the potential benefits and liabilities of this treatment, be established. Initial literature review began in 1997. Several presentations and one open literature submission have been made, based on shared work and data with the Navy, when one principal investigator (PI) was in a joint assignment last year.

Visual Performance with Electro-Optical Displays

Increasing emphasis on night and continuous operations has significantly enhanced the role of helmet-mounted visual displays for aviation and ground forces. While current systems rely on cathode ray tube (CRT) technology, flat panel displays are much lighter, thinner, and consume less power than CRTs making them well-suited for head and helmet mounted systems under development. The Visual Sciences Branch Electro-Optics Team plays a major role in evaluation of flat panel displays and prototype systems.

In 1997, 10 articles were published regarding a variety of flat panel display technologies. A detailed test plan for evaluation of developing systems was completed, in support of the Comanche and Army Common Helmet Programs. Performance and health hazard questions for the Comanche system were revisited. Documents on helmet-mounted and flat panel displays were completed for ASCC and NATO, with a draft NATO STANAG addressing flat panel display issues being submitted to the working party meeting in Brussels in the fall of this year. A test plan for T&E of the HGU-56P Comanche Compatibility helmet-mounted display was developed and submitted to PM, Aircrew Integrated Systems, St. Louis, MO. A technical report entitled RAH-66 Comanche Health Hazard and Performance Issues for the Helmet Integrated Display and Sighting System (HIDSS) is in review. A study is being developed to determine the number of

perceptible grey levels that are present in flat panel technology displays. Also, program guidance was provided to PM, Comanche, for selection of display technology for the HIDSS.

Military Visual Tests and Retinal Function

Selection and retention of aviation personnel is based on acceptable performance on a number of vision tests. While visual acuity remains the cornerstone of vision assessment, subtle visual loss can escape detection with standard measures of acuity. USAARL scientists developed the small letter contrast test which is more sensitive than visual acuity for detecting small amounts of blur, subtle changes in light intensity, vision with two eyes versus one, visual differences in pilot trainees, and early stages of eye disease. Currently, the small letter contrast test is being used in refractive surgery studies conducted by the Navy, Air Force, and FAA. USAARL scientists have also developed a new, computer-based approach for measuring human color vision. Unlike most clinical color tests, which simply indicate the presence of a color anomaly, this new diagnostic approach reveals type (red, green, or blue) and severity of color deficiency. This approach, which has proven to be more sensitive than standard tests for detecting color deficiency, recently was published in the open literature. Additional research is seeking to correlate clinical retinal status (anatomy and physiology) to abnormal visual test outcomes, in order to model predictive nomograms.

Aircrew Protection Division:

USAARL's Aircrew Protection Division is a team of engineers, aviators, and health care professionals. The team studies the effects of exposure to physical forces, such as noise, repeated impact and jolt, and impact decelerations on the health and performance of Army air and ground combat crewmembers. They study communication performance and causes of chronic injury and attrition. These efforts are accomplished through computer modeling, laboratory simulation, use of crash manikins and human volunteers, investigation of mishaps, study of combat crew life support equipment, and access to crewmember health and injury databases. They recommend injury prevention strategies to equipment developers and major commands.

Acceleration Injury Assessment: Criteria and Methodology

Health hazards likely to be encountered in Army systems include whole-body acceleration and blunt impacts that produce skeletal and internal soft tissue injuries. The methods for injury assessment rely on crash manikins that faithfully reproduce the human biodynamic response to impact. When subjected to impact tests such as landmine blasts, parachute opening shocks, repeated jolt, and vertical seat drops, data from these manikins are processed and evaluated to estimate the risk of injury to exposed soldiers. The USAARL injury assessment software (BLAST), initially developed in 1996 for landmine blast injury assessment, has been utilized in 1997 to evaluate the newly developed Joint Cockpit Airbag System (CABS). Relevant portions of the BLAST software are being incorporated into the ORCA software, developed by the Joint Crew Casualty Assessment (JCCA) workgroup. In 1997, USAARL received sufficient funding to replace the electronics in its recently developed Manikin with Internal Data Acquisition System (MIDAS). The unique spinal structure of MIDAS is softer than the standard automotive Hybrid III manikin. It will undergo sled validation testing in preparation for USAARL's unique customer requirements of crash and other impact tests.

Effects of Head-Supported Mass on Performance

During the last few years, USAARL researchers examined the effects of head-supported mass (HSM) on a pilot's neck muscle fatigue and his ability to track moving targets. The studies found that pilot biomechanical and physiological responses degrade when the weight moment of head-supported devices exceeds 80 Newton-centimeters. This imposes a limit on not only how much weight can be mounted on helmets, but also where it can be mounted relative to the head-neck pivot. The studies, which were conducted using the USAARL multiaxis ride simulator (MARS) and male volunteer subjects, are being repeated with female subjects. Funded by the Defense Women's Health Research Initiative Program (DWHRP), a new research protocol was prepared and received approval in 1997. The new protocol will expose female volunteers to simulated helicopter vibration while wearing helmets with different HSM configurations. Physiological, biomechanical, performance data will be recorded during the tests. Analysis of these data should reveal the threshold of weight moment where HSM effects on the women subjects become significant.

Mathematical Simulations of Aircrew Biodynamics

As part of its core research program, USAARL studies the effects of head-supported devices (HSD) on the risk of aviator's head and neck injury during helicopter mishaps. These studies also evaluate the role of restraint and protective systems, such as inertia reels and inflatable airbag devices, in reducing the severity of injury. A systematic evaluation can be cost-effective only with the use of mathematical simulations of crash scenarios that incorporate biodynamic models of the human body. Literally, thousands of simulations were conducted at USAARL in 1997 using the Articulated Total Body (ATB) model. In many simulations, a flexible neck model was used to improve the accuracy of ATB model predictions. Post-processing software was developed at USAARL to view the result of the crash simulation and to automate the assessment of head and injury. Results of these simulations were published in three open literature articles, presented at two symposia on helmet design and head/neck injury, and included in several USAARL technical reports. Most of the simulations confirmed the helmet weight and center of gravity (CG) location criteria that are advocated by USAARL. However, simulations of some crash scenarios raised questions regarding the validity of previously accepted design limits. These questions will be investigated using a mini-sled impact device that was developed at USAARL specifically for that purpose. The work done at USAARL provided helmet developers and users with weight-CG location standards that they could live by, while continuing to examine the validity of these standards. This assures that a pilot's neck injury risk is not increased as helmet design limits are revised.

Standard for Health Hazard Assessment of Repeated Jolt in Army Vehicles

In 1997, USAARL concluded a 5-year research program that documented human whole-body response to repeated jolt. The research, which was done under contract with British Columbia Research Inc., established safe tolerance thresholds that would be considered hazardous by current standards. The effort resulted also in a new model for health hazard assessment (HHA) that is designed to replace the current ISO standard for repeated jolt. While the new model requires additional field testing before it gains users' acceptance, there is little doubt that the USAARL-produced data have raised the bar well above current conservative limits. The impact of this program is likely to affect how the Army evaluates whole-body vibration, particularly when the vibration signature contains high levels of repeated jolts. By pushing the envelope of known human tolerance and

developing modern methods to assess the health hazard of repeated jolt, USAARL is serving the developer of Army ground vehicles while protecting the health and safety of the soldier.

Development of ALSE and Crashworthiness Design Standards

Supporting the developers of Army aircraft systems and personal protection devices is an ongoing consultation and testing effort at USAARL. Through reconstruction of crashes, static and dynamic testing of systems and devices, the use of manikins and human volunteers, experts derive protection standards and propose product improvements to developers. Protective systems and devices include crashworthy seats, airbag restraints, conventional restraint harnesses, inertia reels, and protective headgear.

In 1997, USAARL researchers conducted follow-on assessments of the RAH-66 Comanche helmet. These assessments showed the operational helmet configuration exceeded the weight and center of mass requirements. As a result of USAARL laboratory and flight tests, the MA-16 inertia reel is retrofitted into the UH-60 helicopter, and planning efforts are underway for the Army's other rotary-wing aircraft. The use of supplementary foam cushions in the TH-67 training helicopter was analyzed which identified several injury risks to the user. As a result, these cushions have been disallowed, reducing the risk of spinal injury during mishap. The new generation helmet for the ground combat soldier (Land Warrior) was evaluated which revealed neck injury hazards due to cable snag. Recommendations for maximum break strength were provided to the materiel developer. The horizontal mini-sled, fabricated in 1996, was calibrated and utilized to assess the dynamic stability and compatibility of the M-45 protective mask and the HGU-56/P aircrew helmet. Additional testing and evaluations were conducted on the Special Operations Forces (SOF) free-fall parachutist training helmet, the Marine Corps new combat vehicle crew (CVC) helmet, and the PASGT paratrooper helmet. Meetings were held with the sister services to coordinate development of a new family of headforms to be used for various helmet tests and manikins.

Mathematical Modeling of Pilot Biodynamics

The forces and accelerations acting on the human body during a helicopter crash or inside an armored vehicle subjected to a mine blast may exceed human tolerance and produce injury to the soldier. Prediction of such injuries is the subject of mathematical

simulations of crashes in which the biodynamics of the pilot are computed and the effectiveness of restraint systems is evaluated. The articulated total body (ATB) model is the primary biodynamic simulation software used in the research.

In 1997, simulations of helicopter pilot dynamics under various crash scenarios continued with the latest version of the ATB software. The influence of seat stroke on allowable head-supported mass was investigated. The distance a seat displaces during vertical impact loads significantly affects the limits of head-supported masses. Airbags were also modeled during 1997, which also significantly affect the head-supported mass limits. The airbag model from the Dynaman model was incorporated into the ATB model. A validation effort was conducted between the ATB response, human volunteer responses, and the mini-sled to illustrate the differences between the ATB flexible neck and the rigid neck link.

Assessment of Aviation Life Support Equipment Performance

Aviation life support equipment (ALSE) includes aviation helmets and clothing, crashworthy seating, and restraint systems. A team of ALSE experts study the performance of ALSE devices recovered from aircraft mishaps. By relating investigation findings with aircrew member injury patterns, the experts propose design and operational improvements to ALSE developers and the user community.

In 1997, under the direction of the Program Manager for Aircrew Integrated Systems (PM-ACIS), ALSE subject matter experts at USAARL custom fitted 25 Army aviators who could not achieve proper helmet fit by conventional means. USAARL experts also conducted four site visits for the PM-ACIS to assess the state of ALSE in the field. Our collective expertise was further called on to recommend changes to the SPH-4B and HGU-56/P helmet liners when used in conjunction with the evolving M-45 protective mask. The liner, developed through team effort, is currently in the operational test phase and will be built for inclusion in all Aircrew Protective Masks (ACPM) or the M-45 protective masks.

Research Epidemiology

During CY97, two papers were published that will have an impact on the U.S. military. The first examined the risk of head and neck injury associated with the use of night vision

goggles (NVGs). It found no increased risk of traumatic injury with the current NVGs, but a three-fold increase in risk with the old PVS-5 types.

The second paper examined a known risk factor for cardiovascular disease, serum cholesterol. We found that cholesterol values among U.S. Army pilots had fallen significantly since 1986. This seems to indicate an improvement in the health status of this group of high value soldiers.

Auditory Performance

This laboratory completed operational assessment of active noise reduction (ANR) systems provided under Cooperative Research and Development Agreements (CRDAs) and compared with standard HGU-66/P and communications earplug (CEP). Results show that CEP is preferred by 55 percent as compared to 33 percent preference for the 'BEST' ANR system. Procurement of 800 CEP devices for an expanded operational test in the OH-58D helicopter was completed. The process of distributing devices to OH-58D units who have HGU-56/P helmets and OH-58D helicopters is underway. At this time, approximately 400 CEP devices are in use by the OH-58D aviators. It is anticipated that the completion of the assessment will be by July or August of 1998.

Auditory Standards

Work has been initiated to measure the acoustic input to aviators during normal operation in support of the development of an auditory performance standard. The first objective of the study will be to determine the noise threat and conditions of the communications equipment in the Army helicopter inventory. Measurements will be conducted during 1998 and 1999. The standard resulting from this study will include clinical tools for assessing an aviator's speech discrimination capability in the helicopter noise environment.

Contracts:

Through sponsorship by the U.S. Army Medical Research and Materiel Command, USAARL maintains an extramural research program in support of its in-house research. Because of manpower constraints, this program is used to provide the research data needed, as well as scientific expertise. These research contractors perform at their own facilities and, in some cases, onsite at USAARL where unique research tools and facilities can be provided at lower cost to the Army.

Present contract efforts include:

- Insert Protection with Communication Enhancement for High Intensity Impulse Noises Environments, Phase III; TPL, Inc. Principal investigator - David W. Cutler.

- Development of a Standard for the Health Hazard Assessment of Mechanical Shock and Repeated Impact in Army Vehicles, British Columbia Research Corporation. Principal investigator - Ms. Barbara Cameron.

- Contributive Research in Aviation Medicine, Bioengineering, Human Performance, Analytic and Modeling Systems and Data Management, Universal Energy Systems, Inc. Principal investigator - Dr. Thomas Harding.

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Technical Memoranda:

Subject: Effects of Head-Supported Weight
Customer Organization: Dismounted battle-lab, Task Force 21, Ft Benning GA

Subject: Review of NVG Tech Assessment--Black Hawk S70A-9 Mid-Air Accident
Customer Organization: Australian Army Aviation Support Group, Oakey QLD

Subject: Assessment and Op Test of Bose ANR and CEP when used w/HGU-56/P
Customer Organization: Bose Corporation

Subject: Assessment and Op Test of Gentex ANR and CEP w/HGU-56/P Helmet
Customer Organization: Gentex Corporation

Subject: Error Analysis of Single-Engine Emergencies
Customer Organization: Aviation Branch Safety Office

Subject: Aircraft Accident Investigation, ALSERP Prelim Findings of Accident 970131
Customer Organization: U.S. Army Safety Center

Subject: A/C Accident Investigation, ALSERP Final Rpt of Findings of Accident 970131
Customer Organization: U.S. Army Safety Center

Subject: Whole-Body Vibration HHA Request, Bradley Mod Program, M2A3/M3A2, Proj 69037-2266-97
Customer Organization: U.S. Army CHPPM

Subject: Test Results of LIF on AN/PVS-7B NVG Performance
Customer Organization: PM-NVRSTA

Subject: LIF Effects on AN/PVS-7B NVG Performance
Customer Organization: PM-NVRSTA

Subject: LIF and ANVIS HUD Effects on ANVIS Performance
Customer Organization: PM-NVRSTA

Subject: Review of Spatial Disorientation Training
Customer Organization: USASAM

Subject: Evaluation of the Spatial Disorientation Sortie in Training
Customer Organization: ATB Commander and USASAM

Subject: A/C Accident Investigation ALSERP Supplemental Rpt of Findings of Accident 970131
Customer Organization: US Army Safety Center

Subject: Whole-Body Vibration HHA on Deployable Universal Combat Earthmover
Customer Organization: US Army CHPPM

Subject: Executive Summary for UH-1 Position Light Study
Customer Organization: USAAVNC

Subject: Background Paper on Inertia Reel Performance
Customer Organization: Air Force Air Mobility Command

Subject: Crew Rest Evaluation
Customer Organization: National Training Center

Subject: Relative Eye Position Changes with 3 Different Thermal Plastic Linder Modifications w/and wo XM45 Aircrew Protective Mask
Customer Organization: PM NBC, APG, MD

Subject: Mine Blast Injury Acceleration Injury Assessment: Methods, Criteria, and Software
Customer Organization: Simula Technologies, Inc.

Subject: Vibration Evaluation of LSTAT at Northrop Grumman
Customer Organization: WRAIR

Subject: WBV HHA of the High Speed Compactor
Customer Organization: US Army CHPPM

Subject: Limited Technical Evaluation of UH-60Q Patient Support System Support Device Compatibility
Customer Organization: U.S. Army Aviation Technical Test Center

Subject: Use of Additional Seat Cushions/Supports in TH-67
Customer Organization: ATB Commander

Subject: SBIR Proposal Reviews
Customer Organization: USAMRMC

Subject: Review of Proposed Test Plan to Evaluate Effects of Fan-Blade Out Whole-Body Vibration
Customer Organization: Boeing

Subject: LSTAT Vibration Testing
Customer Organization: WRAIR

Subject: Mission Need Statement for an Aircrew Cooling System
Customer Organization: USAMRMC

Subject: Mass Properties Test Results, SPH-5CF & 190-C Helmets w/Low Profile NVGs
Customer Organization: Canadian Defence & Civil Institute of Environmental Medicine

Subject: Simula Proposed Criteria for CABS Injury Assessment
Customer Organization: ATCOM, Aviation Applied Technology Directorate

Subject: Tolerance of Human Neck in Lateral Bending
Customer Organization: AMEDDC&S

Subject: Aircraft Accident Investigation, ALSERP Report of Findings of Accident 970301
Customer Organization: US Army Safety Center

Subject: WBV HHA, Opposing-Forces Surrogate Vehicle
Customer Organization: US Army CHPPM

Subject: Optical Evaluation of Polycarbonate Lenses fm Original CR3-9 Lenses in M40/M42 Protective Mask
Customer Organization: PM NBC

Subject: Report of Findings on USAF A-10A Mishap
Customer Organization: Life Sciences Equipment Lab, Kelly AFB

Subject: Durability Tests on the Bali Song Switchblade Knife
Customer Organization: Directorate of Combat Development, USAAVNC

Subject: Aircraft Accident, ALSERP, Report of Findings of Accident 970930
Customer Organization: US Army Safety Center

Subject: Health Hazard Assessment of Whole Body Vibration for M917A1 Dump Truck
Customer Organization: US Army CHPPM

Subject: LifePak 10 Defibrillator/Monitor
Customer Organization: Physio-Control

Subject: Final Report: Development of a Cockpit Air Bag System
Customer Organization: ATCOM, Aviation Applied Technology Directorate

Subject: Final Report: Development of a Cockpit Air Bag System
Customer Organization: ATCOM, Aviation Applied Technology Directorate

Subject: Whole-Body Vibration HHA of the D7R Tractor
Customer Organization: US Army CHPPM

Subject: ALSERP, Report of Findings of Accident 970708
Customer Organization: USASC

Consultations:

Subject: Spatial Disorientation Mishaps
Customer Organization: U.S. Army Safety Center

Subject: NVG Performance
Customer Organization: British Colombia Research Inc.

Subject: Low light level target detection
Customer Organization: TRW Government Information Services Division

Subject: Request for ALSERP Briefing
Customer Organization: Fort Rucker Reserve Aviation Component

Subject: ALSERP Data Collection Requirements Information Request
Customer Organization: 12th Aviation Brigade ALSE

Subject: Mishap 970201 In Brief
Customer Organization: U.S. Army Safety Center

Subject: Technical Reviewer of HRED Protocol
Customer Organization: HRED

Subject: HGU-56/P helmet fit for compatibility with ANVIS
Customer Organization: B Co. 1-228th Aviation Battalion

Subject: Review of manuscript for technical report
Customer Organization: HRED

Subject: SD demonstration sortie
Customer Organization: Aviation Training Brigade

Subject: Spatial Disorientation Demonstration sortie
Customer Organization: USASAM

Subject: Spatial Disorientation - FLIGHTFAX article
Customer Organization: USASC

Subject: Fatigue induced performance decrements
Customer Organization: National life saving association of Iceland

Subject: AR 95-3 Crew Endurance Guide
Customer Organization: Directorate of Evaluation and Standardization

Subject: Extended work periods, fatigue, and performance
Customer Organization: Emergency Medical Service, Johnson City, TN

Subject: Ship-Shock Vulnerability Assessment
Customer Organization: Naval Sea System Command, Washington, D.C.

Subject: Acceleration Injury - Lower extremities
Customer Organization: Swedish Defence Research Establishment (FOA)

Subject: Improvements in protection of newer generation helmets (SPH-4B, etc)
Customer Organization: Army National Guard Readiness Center

Subject: Litters
Customer Organization: Defense Medical Standardization Board

Subject: Nylon hazard for fuel handlers wearing the new BDU
Customer Organization: 5th Army Safety Manager

Subject: Noise exposure in the Comanche helicopter
Customer Organization: ATCOM

Subject: Evaluation of the CEP in the H-53 helicopter
Customer Organization: Naval Air Warfare Center, AD , Patuxent River, MD

Subject: Energy Attenuating Seat Background Data
Customer Organization: U.S. Navy

Subject: Corneal Topography
Customer Organization: EENT, Lyster

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Customer Organization: EENT, Lyster

U.S. Army Aeromedical Research Laboratory--Calendar Year 1997

Subject: Vision Standards
Customer Organization: Warrant Officer Advanced Course, Fort Rucker, AL

Subject: Commercial hours of service regulations for drivers
Customer Organization: National Sleep Foundation

Subject: SD accidents
Customer Organization: USASC

Subject: Flight Physical Assistance
Customer Organization: EENT, Lyster

Subject: NVG briefing
Customer Organization: Israeli Air Force Academy

Subject: Consultation: Contact Lens Program
Customer Organization: Aerospace Medicine, Lyster

Subject: Briefing to Australian Army NVG Instructor Pilot
Customer Organization: Australian Army Aviation Support Group, Oakey QLD

Subject: Aircraft NVG "friendly" position lights
Customer Organization: Grimes Aerospace

Subject: Comments on design specs of tracked vehicle
Customer Organization: U.S. Army CHPPM

Subject: Night vision goggle operations and maintenance
Customer Organization: Australian RAAF Base Edinburgh

Subject: Moon Illumination Information
Customer Organization: DES, Fort Rucker

Subject: NVG and Human Factors Research
Customer Organization: Defence Science and Technology Organisation, AMRL, Australian

Subject: Proper Wear of the ABDU
Customer Organization: 304th MI, Ft Huachuca

Subject: Proper wear of the ABDU
Customer Organization: DynCorp Safety, Lowe AAF

Subject: Myopia progression control
Customer Organization: University of Alabama School of Optometry

Subject: Using Canned Water In AMSS Kits
Customer Organization: PM-AIS

Subject: Boots Authorized for Flight Use
Customer Organization: U.S. Air Force, Hurlbert Field

Subject: Wearing Survival Vest in Fixed Wing Aircraft
Customer Organization: Aviation Safety Officer (ASO) List Server

Subject: QDR for failed microphone identified in ALSERP case
Customer Organization: U.S. Army Safety Center

Subject: BDU, Brown Sweater, and Nomex Turtle Neck
Customer Organization: Aviation Training Brigade

Subject: ABDU, Brown Sweater, and Nomex Turtle Neck
Customer Organization: AG, Fort Rucker

Subject: Fatigue in transportation operations
Customer Organization: Norfolk Souther Corporation

Teaching Services:

Subject: Teaching Safety Officers Course
Customer Organization: U.S. Army Safety Center

Subject: Crew endurance
Customer Organization: USASAM

Subject: SD accidents
Customer Organization: USASAM

Subject: Briefing to CH-47 NVG IPs
Customer Organization: ATB Commander

Subject: Control of aviator fatigue
Customer Organization: USASAM

Subject: Aviator fatigue and performance
Customer Organization: U.S. Army National Guard

Field Services:

Subject: Endurance Management/Desynchronosis Prevention--Guest Speaker
Customer Organization: Army War College

Subject: U.S. Coast Guard Crew Rest Evaluation
Customer Organization: U.S. Coast Guard

Subject: Electro-Optics Target Detection Workshop
Customer Organization: Wright-Patterson AFB

Committees:

Aerospace Medical Association		
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Z90.1 Helmet Committee	Member	Mr. B. J. McEntire
S12 WG10 Working Group on Hearing Protector Attenuation	Member	Mr. B. T. Mozo
S12 WG11 Working Group on Field Effectiveness & Physical Characteristics of Hearing Protectors	Member	Mr. B. T. Mozo
S12 WG29 Working Group on Assessment Methodologies for Nonlinear Hearing Protection	Member	Mr. B. T. Mozo
Department of Defense		
Joint Service Display Panel Subpanel on Display Devices	Member	Mr. C. E. Rash
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Triservice Refractive Surgery Group Important Medications Working Group	Member	COL M. R. Lattimore, Jr.
Technical Working Group in Situational Awareness and Spatial Disorientation	Member	LTC Philip A. Johnson
Triservice Aviator Helmet Standardization Working Group	Member Member	Mr. J. R. Licina Mr. B. J. McEntire
Triservice Enhanced Noise Reduction (TENOR)	Member	Mr. B. T. Mozo
Joint Cockpit Airbag System Working Group	Member	Mr. B. J. McEntire
Triservice Biodynamics Working Group	Chairman Member	Mr. B. J. McEntire Dr. N. M. Alem
Joint Service General Purpose Mask Working Group	Member (Non-Voting)	Dr. W. E. McLean
National Sleep Foundation Speaker Bureau	Member	Dr. J. A. Caldwell

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Aeromedical Aspects of Biodynamics Stress Project Group 103	Project Officer	Mr. B. T. Mozo
WP61 for Spatial Disorientation	Consultant	LTC Philip A. Johnson

The Technical Cooperation Program

Subgroup U, UTP-7, Human Factors in Aircraft Environments	Army Representative	LTC J. S. Crowley
Working Technical Panel (WTP) 1 Key Technical Area (KTA) 1-29 Protection of Wheeled Vehicle Occupants from Landmine Effects	Member	Dr. N. M. Alem